WE CLAIM:

1. A copper diffusion barrier film for use in a semiconductor device, the copper diffusion barrier film formed of a silicon-based material doped with boron, wherein the copper diffusion barrier film maintains a stable dielectric constant of less than 4.5 in the presence of atmospheric moisture.

2. The copper diffusion barrier of claim 1, wherein the copper diffusion barrier film maintains a stable dielectric constant of between 3.0 and 4.5 in the presence of atmospheric moisture.

3. The copper diffusion barrier of claim 1, wherein the silicon-based material comprises silicon nitride.

4. The copper diffusion barrier of claim 1, wherein the silicon-based material comprises silicon carbide.

5. The copper diffusion barrier film of claim 1, further comprising:

a first layer of boron-doped silicon nitride; and

a second boron-doped layer comprising silicon and one or more elements selected from the group consisting of carbon, nitrogen and oxygen.

6. The copper diffusion barrier film of claim 1, further comprising:

a first layer of boron-doped silicon carbide; and

a second boron-doped layer comprising silicon and one or more elements selected from the list of elements consisting of carbon, nitrogen and oxygen.

7. The copper diffusion barrier film of claim 1, wherein the copper diffusion barrier has a thickness in the range of 100 Å to 1500 Å.

8. A partially fabricated semiconductor device, comprising:

a metal interconnect formed substantially of copper; and

a copper diffusion barrier adjacent the metal interconnect, the copper diffusion barrier formed of a silicon-based material doped with boron.

9. The device of claim 8, wherein the copper diffusion barrier maintains a stable dielectric constant of between 3.0 and 4.5 in the presence of atmospheric moisture.

10. The device of claim 8, wherein the silicon-based material comprises a compound selected from the list comprising silicon nitride and silicon carbide.

11. The device of claim 8, wherein the copper diffusion barrier further comprises:

a first layer of boron-doped silicon nitride; and

a second boron-doped layer comprising silicon and one or more elements selected from the list of elements consisting of carbon, nitrogen and oxygen.

12. The device of claim 8, wherein the copper diffusion barrier further comprises:

a first layer of boron-doped silicon carbide; and

a second boron-doped layer comprising silicon and one or more elements selected from the list of elements consisting of carbon, nitrogen and oxygen.

13. The device of claim 1, wherein the copper diffusion barrier has a thickness in the range of 100 Å to 1500 Å.

14. The device of claim 1, wherein the copper diffusion barrier has a composition in the following ranges: $Si_{0.1-0.3}B_{0.2-0.6}N_{0.1-0.5}$.

15. The device of claim 1, wherein the copper diffusion barrier has a composition of $Si_1B_2N_1$.

16. The device of claim 1, wherein the copper diffusion barrier has a composition of $Si_1B_3N_1$.

17. A copper diffusion barrier film for use in a semiconductor device, the copper diffusion barrier film comprising:

a first layer of boron nitride or silicon boron nitride ; and

a second layer comprising boron and one or more elements selected from the list of elements consisting of silicon, carbon, nitrogen and oxygen, wherein the copper diffusion barrier film maintains a stable dielectric constant of less than 4.5 in the presence of atmospheric moisture.

18. A method of forming at least a portion of a semiconductor device, the method comprising:

forming a trench in a first dielectric layer;

depositing a metal diffusion barrier in the trench;

depositing a copper seed layer on the metal diffusion barrier;

forming a copper interconnect on the copper seed layer; and

forming a copper diffusion barrier on the copper interconnect, the copper diffusion barrier formed of a silicon-based material doped with boron.

19. The method of claim 18, further comprising:

removing copper oxide from the copper layer prior to forming the copper diffusion barrier on the copper layer.

20. The method of claim 18, wherein the step of forming a copper diffusion barrier comprises a plasma-enhanced chemical vapor deposition technique.

21. The method of claim 18, wherein the step of forming a copper diffusion barrier comprises flowing silane gas at rates in the range of approximately 50 to 300 standard cubic centimeters per minute.

22. The method of claim 21, wherein the step of forming a copper diffusion barrier comprises flowing diborane gas at rates in the range of approximately 2000 to 10000 standard cubic centimeters per minute.

23. The method of claim 22, wherein the step of forming a copper diffusion barrier comprises flowing ammonia gas at rates in the range of approximately 250 to

2000 standard cubic centimeters per minute or flowing nitrogen gas at rates in the range of approximately 0 to 8000 standard cubic centimeters per minute .

24. The method of claim 22, wherein the step of forming a copper diffusion barrier comprises:

flowing silane gas at approximately 50 standard cubic centimeters per minute;

flowing a diborane/argon gas mixture at approximately 9000 standard cubic centimeters per minute; and

flowing ammonia gas at approximately 500 standard cubic centimeters per minute.

25. The method of claim 18, wherein the removing step comprises exposing the copper layer to a gas selected from a list consisting of ammonia gas and hydrogen gas.

26. The method of claim 18, wherein the plasma-enhanced chemical vapor deposition technique is performed at temperatures in the range of approximately 200 degrees Centigrade to 400 degrees Centigrade.

27. The method of claim 20, wherein the plasma-enhanced chemical vapor deposition technique is performed at pressures in the range of approximately .1 torr to 10 torr.

28. The method of claim 20, wherein the plasma-enhanced chemical vapor deposition technique is performed at frequencies in the range of approximately 200 to 500 kHz.

29. The method of claim 20, wherein the plasma-enhanced chemical vapor deposition technique is performed at a frequency of approximately 13.56 MHz or approximately 27 MHz.

30. The method of claim 18, wherein the step of forming a copper diffusion barrier comprises using a borane complex for a boron source.

31. The method of claim 30, wherein the borane complex comprises dimethylamine borane or trimethyl borane.